(19) JAPANESE PATENT OFFICE

PATENT ABSTRACTS OF JAPAN

(11) Publication number: **10214020 A**

(43) Date of publication of application: **11.08.98**

(51) Int. Cl **G03H 1/22**
G02B 5/32
G03H 1/30

(21) Application number: **09018653**

(22) Date of filing: **31.01.97**

(71) Applicant: **TOPPAN PRINTING CO LTD**

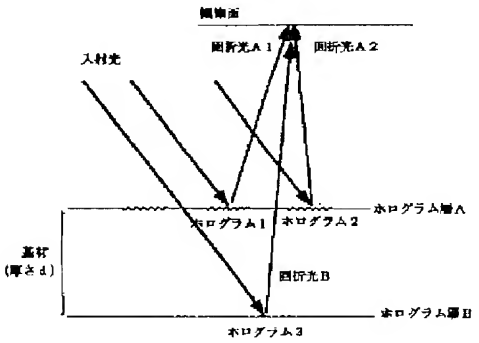
(72) Inventor: **TODA TOSHITAKA**

(54) TWO-LAYERED STRUCTURE HOLOGRAM

(57) Abstract:

PROBLEM TO BE SOLVED: To disable accurate reproduction unless specific illumination light for reproduction is used by making good use of coherent characteristics of illumination light for reproduction used for the wave front reproduction of a hologram.

SOLUTION: Incident light having some coherence characteristics is made incident on the hologram, part of it is made incident on element holograms 1 and 2 in a hologram layer A, and diffracted light beams A1 and A2 are projected. The element holograms 1 and 2 are so arranged that the optical path difference between those diffracted light beams is within a distance range wherein the coherence degree of a light source used for reproduction is high, so the diffracted light beams A1 and A2 have relation of a high degree of coherence. Hologram layers A and B, on the other hand, have a distance, double as long as their interval (d), set to such an optical distance that the degree of coherence between the diffracted light beams from both the layers is low, so the diffracted light beams (A1, A2) from the hologram layer A on an observation surface and the diffracted light B from the hologram layer B has relation of a low degree of coherence.



Filing info	Patent H09-018653 (31.1.1997)
Publication info	H10-214020 (11.8.1998)
Detailed info of application	Kind of examiner's decision(Grant)
Date of request for examination	(15.12.2003)
Registration info	4154738 (18.7.2008)
Renewal date of legal status	(18.7.2008)

Legal status information includes 8 items below. If any one of them has any data, a number or a date would be indicated at the relevant part.

1. Filing info(Application number,Filing date)
2. Publication info(Publication number,Publication date)
3. Detailed info of application
   * Kind of examiner's decision
   * Kind of final decision
   * Date of final decision in examination stage
4. Date of request for examination
5. Date of sending the examiner's decision of rejection(Date of sending the examiner's deci
6. Appeal/trial info
   * Appeal/trial number,Date of demand for appeal/trial
   * Result of final decision in appeal/trial stage,Date of final decision in appeal/trial st
7. Registration info
   * Patent number,Registration Date
   * Date of extinction of right
8. Renewal date of legal status

For further details on Legal-Status, visit the following link.PAJ help(1-5)

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]A duplicate and imitation are difficult, and has a high security effect (forgery prevention effect), and this invention relates to the hologram which also has an effect of concealment of recorded information.
[0002]
[Description of the Prior Art]The type of the conventional hologram for which the thing of layer structure had spread widely and several different element holograms were formed in the same flat surface is also publicly known. On the other hand, the hologram of multiple layer structure (type in which the relief hologram was formed to both sides) also exists.
[0003]However, about the known art taken into consideration about the coherent characteristic between the diffracted lights from each hologram (or a different element hologram within the same flat surface) of a double layer, there is still no example of a report. Therefore, the diffracted light from the existing hologram was dealt with as the independent diffracted light of each hologram.
[0004]
[Problem(s) to be Solved by the Invention]An object of this invention unless the specific illumination light for reproduction is used using the coherent characteristic of the illumination light for reproduction used at the time of the wavefront reconstruction of a hologram is to propose the hologram in which exact reproduction is impossible.
[0005]
[Means for Solving the Problem]In a hologram which is a medium by which a hologram by claim 1 of this invention reproduces a wave front of light, So that it may consist of a hologram of a mutual almost parallel bilayer and may become in a range scale where a coherence factor of a light source which the optical path difference of the diffracted light from two or more element holograms which can be set in the layer at each class uses for reproduction is high, There are two or more element holograms and the optical path difference of the diffracted light from a hologram of a bilayer decided depending on an interval of a bilayer is in a range scale where a coherence factor of said light source is low.
[0006]In a hologram which is a medium by which a hologram of claim 2 reproduces a wave front of light, So that it may consist of a hologram of a mutual almost parallel bilayer and may become in a range scale where a coherence factor of a light source which the optical path difference of the diffracted light from two or more element holograms which can be set in the layer at each class uses for reproduction is high, There are two or more element holograms and the optical path difference of the diffracted light from the element holograms of each class decided depending on an interval of a bilayer is in a range scale where a coherence factor of said light source is high.
[0007]A hologram of claim 3 is characterized by a hologram of a bilayer being a transmission type hologram, respectively.
[0008]A hologram of claim 4 is characterized by a hologram of a bilayer being a reflection type hologram, respectively.
[0009]Among holograms of a bilayer, in at least one layer, an element hologram leaves a hologram of claim 5 spatially, and it is arranged.
[0010]A hologram of claim 6 is characterized by an element hologram being a surface relief type hologram.
[0011]As for a hologram of claim 7, a hologram of a bilayer is formed in a rear surface of a substrate of one

sheet, respectively.
[0012]
[Embodiment of the Invention]Hereafter, the embodiment of this invention is described. Embodiments 1 and 2 are subordinate to claim 1, and Embodiments 3 and 4 are embodiments subordinate to claim 2.
[0013]<Embodiment 1> drawing 1 is an explanatory view showing the reproduction state of a reflection type hologram. The incident light which has a certain coherence property enters into a hologram, it enters into the element holograms 1 and 2 which have the part in the hologram layer A, and the diffracted light A1 and A2 are emitted. Since the element holograms 1 and 2 are arranged so that it may become in the range scale where the coherence factor of the light source which the optical path difference of the diffracted light from them uses for reproduction is high, the diffracted light A1 and A2 have a relation with a high coherence factor. There are two or more element holograms so that it may become each class in the range scale where the coherence factor of the light source which the optical path difference of the diffracted light from two or more element holograms which can be set in the layer uses for reproduction is high, [0014]In the observed face of the figure, it is observed as a square (= intensity) of the diffracted light A1 from the hologram layer A, and the coherent sum (drawing 3 (4)) of complex amplitude distribution (shown in drawing 3 (1) and (2)) of A2.
[0015]On the other hand, since the interval d twice the distance of the is set as the optical distance to which the coherence factor of the diffracted lights from both layers becomes low, the hologram layers A and B, As for the diffracted light (A1, A2) from the hologram layer A in an observed face, and the diffracted light B from the hologram layer B (complex amplitude distribution shown in drawing 4 (3)), a coherence factor has a low relation (incoherent).
[0016]When the diffracted light where a coherence factor has a high relation is put together, it is observed as the sum of complex amplitude distribution. (Drawing 3 (1) + drawing 3 (2) -> drawing 3 (4))
When the diffracted light where a coherence factor has a low relation is put together, it is observed as the sum of intensity (square of complex amplitude) distribution of the diffracted light. (The square of square + drawing 3 (3) of drawing 3 (4) -> drawing 3 (c))
[0017]Therefore, in an observed face, the sum (drawing 3 (c)) of the intensity distribution of the diffracted light A1 from the hologram layer A and the coherent sum of A2 and the intensity distribution of the diffracted light B is observed.
[0018]Since the above-mentioned thing is similarly realized even when each class comprises more element holograms, in an observed face, the intensity sum to the coherent sum of the diffracted light for each class is observed.
[0019]It depends for the above-mentioned reproduction condition on spatial arrangement of the element hologram in each class, the distance between each class, and the coherence property of the light used for reproduction. Therefore, the hologram of this invention designed to a certain specific light is observed as mentioned above only with a certain specific light.
[0020]For example, the range scale where a coherence factor is higher than the light of the set-up coherence property serves as intensity distribution (drawing 3 (b)) which differs in all the above-mentioned diffracted lights from the intensity distribution (drawing 3 (c)) which will be piled up coherent on an observed face and observed on the above conditions to a large light.
[0021]To light (or incoherent light) with a narrow range scale where a coherence factor is higher than the light of the set-up coherence property, the sum of the intensity of all the diffracted lights appears in an observed face (drawing 3 (a)), and it is drawing 3 (c) too. It becomes a different audit observation. Incoherent lighting conditions are general view conditions, such as observation under fluorescent lamp lighting.
[0022]As mentioned above, except the regenerated light which has the set-up coherence property, the right audit observation in the hologram of this invention is not obtained.
[0023]Here under proper conditions (conditions of observing/measuring in the observed face which illuminates at the angle set up with the light source of the specified wavelength with the designed coherence factor, and is in the set-up distance), The truth-or-falsehood nature of a hologram can be judged by carrying out machinery reading of the intensity distribution reproduced from the hologram of this invention with viewing or a detector.
[0024]On the other hand, if proper conditions are not known, exact reproduction of this hologram is impossible, and it turns out that it has high information-hiding nature.
[0025]When it is going to forge the hologram of this invention, since it is the two-layer structure, a mechanical duplicate, such as taking a mold, is difficult. Each surface of the bilayer of the hologram of this invention may be covered by resin etc. so that it cannot mold, and the mechanical duplicate is substantially impossible in this

case.
[0026]On the other hand, when it is going to reproduce the hologram of this invention optically, if the light which has a high coherence factor generally is not used, exposure (duplicate) of a hologram is difficult, all the element holograms are reproduced by a coherent relation in this case, and reproduction results completely differ.
[0027]<Embodiment 2> drawing 2 is an explanatory view showing the reproduction state of the transmission type hologram of this invention. It needs to be set as the optical distance to which the function of a hologram is almost the same as Embodiment 1, and the coherence factor of the diffracted light from the hologram of each class becomes low in the interval d of a bilayer.
[0028]If the substrate of thickness equal to the twice (in the case of a reflection type) of the intervals d (in the case of a transmission type) and d of a bilayer is used as illustrated, the two-layer structure hologram of Embodiments 1 and 2 can fabricate two hologram layers to the rear surface of a substrate, and will become a simple structure. Strictly, only in the case of the refractive index n= 1 of a substrate, this theory is the right. Since an optical distance increases n times in not being n= 1, it is necessary to make thickness of a substrate into d/n.
[0029]Since in the above-mentioned case in incident light and the diffracted light d or 2 d become the optical path difference when near vertically [both], the interval d can be designed easily. The suitable interval d which will be satisfied also with cases other than the above of Embodiments 1 and 2 if the difference of the light path length by this is searched for in consideration of the direction of an incidence angle and an angle of diffraction can be set up.
[0030]Thus, in this invention, since the direction in the case of a reflection type hologram can shorten optical distance, there is a merit which can make a hologram substrate thin. Since in the case of a transmission type hologram it can be used even if it does not carry out a surface treatment which forms a reflection film by a surface relief type hologram, it can carry out by low cost simple.
[0031]If each element hologram is close in the hologram layer A, Only the ingredient (zero-order diffracted light from the element hologram of the hologram A) of the light which penetrated the hologram layer A will enter into the element hologram of the hologram layer B, and the light volume which contributes to reproduction of the element hologram of the hologram layer B will become less.
[0032]However, since the element hologram of the hologram layer B is renewable by the incident light (it has hardly decreased) which penetrates the field where an element hologram does not exist in the hologram layer A by detaching an element hologram spatially and arranging it, utilization efficiency of light can be made high, The intensity ratio of the diffracted light from the hologram of both layers can be made the optimal.
[0033]By making high transmissivity of the spatial field where an element hologram does not exist in the hologram layer A, this effect becomes much more remarkable. Also when the diffracted light from the hologram layer B penetrates the hologram layer A in the case of a reflection type hologram like Embodiment 1, the above-mentioned argument is effective.
[0034]Spatial arrangement of the element hologram in the hologram layer B becomes important in the case of a transmission type hologram like Embodiment 2, in order to penetrate efficiently each diffracted light from the hologram layer A.
[0035]Therefore, by detaching an element hologram spatially and arranging it, coherence property becomes clear and truth judgement becomes still easier.
[0036]<Embodiment 3> drawing 4 is an explanatory view showing the reproduction state of a reflection type hologram. The incident light which has a certain coherent characteristic enters into a hologram, it enters into the element holograms 1 and 2 which have the part in the hologram layer A, and the diffracted light A1 and A2 are emitted.
[0037]Since the element holograms 1 and 2 are arranged so that it may become in the range scale where the coherence factor of the light source which the optical path difference of the diffracted light from them uses for reproduction is low, the diffracted light A1 and A2 have a relation with a low coherence factor. Therefore, in an observed face, the sum of the diffracted light A1 from the hologram layer A and the incoherent intensity distribution of A2 is observed. That is, the sum of the square of the complex amplitude (drawing 6 (1)) of the diffracted light A1 and the square of the complex amplitude (drawing 6 (2)) of the diffracted light A2 is equivalent to the sum of incoherent intensity distribution.
[0038]On the other hand, the diffracted light from the hologram of the hologram layer A and the diffracted light from the hologram of the hologram layer B, Since optical distance (an interval twice the distance of d) is set up become the conditions that the coherence factor of the diffracted lights from both layers is high, As for the

diffracted light (A1, A2) from the hologram layer A in an observed face, and the diffracted light B3 from the hologram layer B, a coherence factor has a high relation (coherent).
[0039]Therefore, in an observed face, it is observed as the sum of the diffracted light A1 from the hologram layer A, and the incoherent intensity distribution of A2, and the coherent sum with the diffracted light B.
[0040]In other words, it is observed as the coherent sum (drawing 6 (4)) of the complex amplitude (drawing 6 (1)) of the diffracted light A1, and the complex amplitude (drawing 6 (3)) of the diffracted light B, and the sum of incoherent intensity distribution with the diffracted light A2. (The square of square + drawing 6 (2) of drawing 6 (4) -> drawing 6 (c))
[0041]Since the above-mentioned thing is similarly realized even when each class comprises more element holograms, in an observed face, the intensity sum to the coherent sum of the diffracted light for each class is observed.
[0042]It depends for the above-mentioned reproduction condition on the degree of incidence angle of spatial arrangement of the element hologram in each class, the distance between each class, the coherence property of the light used for reproduction, and the regenerated light to a hologram. Therefore, the hologram of this invention designed to a certain specific light is observed as mentioned above only with a certain specific light.
[0043]For example, the range scale where a coherence factor is higher than the light of the set-up coherence property serves as intensity distribution (drawing 6 (b)) which differs in all the above-mentioned diffracted lights from the intensity distribution (drawing 6 (c)) which will be piled up coherent on an observed face and observed on the above conditions to a large light.
[0044]To light (or incoherent light) with a narrow range scale where a coherence factor is higher than the light of the set-up coherence property, the sum of the intensity of all the diffracted lights appears in an observed face (drawing 6 (a)), and it is drawing 6 (c) too. It becomes a different audit observation.
[0045]<Embodiment 4> drawing 5 is an explanatory view showing the reproduction state of the transmission type hologram of this invention. The function of a hologram is almost the same as Embodiment 3, the interval d of the bilayer needs to be set as the optical distance to which the coherence factor of the diffracted light from the hologram of each class becomes high, and the audit observation of a hologram becomes being the same as that of Embodiment 3.
[0046]If the substrate of thickness equal to the twice (in the case of a reflection type) of the intervals d (in the case of a transmission type) and d of a bilayer is used as illustrated, the two-layer structure hologram of Embodiments 3 and 4 can fabricate two hologram layers to the rear surface of a substrate, and will become a simple structure. Strictly, only in the case of the refractive index n= 1 of a substrate, this theory is the right. Since an optical distance increases n times in not being n= 1, it is necessary to make thickness of a substrate into d/n.
[0047]Since in the above-mentioned case in incident light and the diffracted light d or 2 d become the optical path difference when near vertically [both], the interval d can be designed easily. The suitable interval d which will be satisfied also with cases other than the above of Embodiments 3 and 4 if the difference of the light path length by this is searched for in consideration of the direction of an incidence angle and an angle of diffraction can be set up.
[0048]If each element hologram is close in the hologram layer A, Only the ingredient (zero-order diffracted light from the element hologram of the hologram A) of the light which penetrated the hologram layer A will enter into the element hologram of the hologram layer B, and the light volume which contributes to reproduction of the element hologram of the hologram layer B will become less.
[0049]However, since the element hologram of the hologram layer B is renewable by the incident light (it has hardly decreased) which penetrates the field where an element hologram does not exist in the hologram layer A by detaching an element hologram spatially and arranging it, utilization efficiency of light can be made high, The intensity ratio of the diffracted light from the hologram of both layers can be made the optimal.
[0050]By making high transmissivity of the spatial field where an element hologram does not exist in the hologram layer A, this effect becomes much more remarkable. Also when the diffracted light from the hologram layer B penetrates the hologram layer A in the case of a reflection type hologram like Embodiment 3, the above-mentioned argument is effective.
[0051]Spatial arrangement of the element hologram in the hologram layer B becomes important in the case of a transmission type hologram like Embodiment 4, in order to penetrate efficiently each diffracted light from the hologram layer A.
[0052]Therefore, by detaching an element hologram spatially and arranging it, coherence property becomes clear

and truth judgement becomes still easier.
[0053]As mentioned above, although "amplitude" was expressing the light which should be treated as complex amplitude in Embodiments 1-4, it is necessary to take a "phase" into consideration actually. Although the phase has carried out simple handling by giving numerals to amplitude in above-mentioned explanation as a thing only expressing the state of 0 (amplitude just corresponds) and pi (amplitude corresponds to negative), When you actually consider arbitrary phases, in an above-mentioned argument, it should be dealt with as the sum of complex amplitude which also took the phase into consideration in coherent superposition. Since the square of amplitude becomes luminous intensity when incoherent, the same handling as **** may be sufficient.
[0054]
[Effect of the Invention]Unless the specific illumination light for reproduction is used by this invention according to the coherence property (and coherence property between element holograms) of the illumination light for reproduction used at the time of the wavefront reconstruction of a hologram, the hologram in which exact reproduction is impossible is provided.
[0055]

[Translation done.]

* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1]It consists of a hologram of a mutual almost parallel bilayer in a hologram which is a medium which reproduces a wave front of light, So that it may become each class in a range scale where a coherence factor of a light source which the optical path difference of the diffracted light from two or more element holograms which can be set in the layer uses for reproduction is high, A two-layer structure hologram, wherein there are two or more element holograms and the optical path difference of the diffracted light from a hologram of a bilayer decided depending on an interval of a bilayer is in a range scale where a coherence factor of said light source is low.
[Claim 2]It consists of a hologram of a mutual almost parallel bilayer in a hologram which is a medium which reproduces a wave front of light, So that it may become each class in a range scale where a coherence factor of a light source which the optical path difference of the diffracted light from two or more element holograms which can be set in the layer uses for reproduction is high, A two-layer structure hologram, wherein there are two or more element holograms and the optical path difference of the diffracted light from the element holograms of each class decided depending on an interval of a bilayer is in a range scale where a coherence factor of said light source is high.
[Claim 3]The two-layer structure hologram according to claim 1 or 2, wherein a hologram of a bilayer is a transmission type hologram, respectively.
[Claim 4]The two-layer structure hologram according to claim 1 or 2, wherein a hologram of a bilayer is a reflection type hologram, respectively.
[Claim 5]The two-layer structure hologram according to any one of claims 1 to 4, wherein an element hologram separates spatially and is arranged in at least one layer among holograms of a bilayer.
[Claim 6]The two-layer structure hologram according to any one of claims 1 to 5, wherein an element hologram is a surface relief type hologram.
[Claim 7]The two-layer structure hologram according to any one of claims 1 to 6, wherein a hologram of a bilayer is formed in a rear surface of a substrate of one sheet, respectively.

[Translation done.]

DESCRIPTION OF DRAWINGS

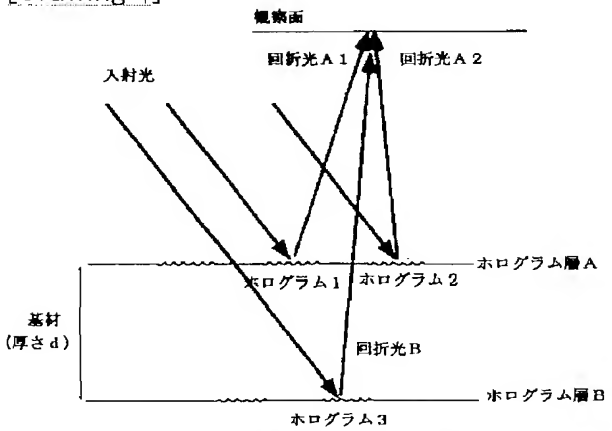
[Brief Description of the Drawings]
[Drawing 1]The explanatory view showing the reproduction state of the reflection type hologram of this invention.
[Drawing 2]The explanatory view showing the reproduction state of the transmission type hologram of this invention.
[Drawing 3]It is an explanatory view showing complex amplitude distribution and intensity distribution of the diffracted light (and when they are piled up) from the hologram concerning Embodiments 1 and 2, (1) Complex amplitude distribution of the diffracted light from the element hologram 1 of **** A, and (2) Complex amplitude distribution of the diffracted light from the element hologram 2 of the layer A, (3) Complex amplitude distribution of the diffracted light from the element hologram 3 of **** B, and (4) Complex amplitude distribution about peace with the coherent diffracted light from the element holograms 1 and 2 of the layer A, (a) Distribution of the sum of the intensity (square of complex amplitude) of the diffracted light from ********** 1, 2, and 3, (b) Distribution of the intensity about peace with the coherent diffracted light from ********** 1, 2, and 3 (square of complex amplitude), and (c) It is the intensity distribution of the regenerated light detected only when the hologram concerning Embodiments 1 and 2 is illuminated appropriately.
[Drawing 4]The explanatory view showing the reproduction state of the reflection type hologram of this invention.
[Drawing 5]The explanatory view showing the reproduction state of the transmission type hologram of this invention.
[Drawing 6]It is an explanatory view showing complex amplitude distribution and intensity distribution of the diffracted light (and when they are piled up) from the hologram concerning Embodiments 3 and 4, (1) Complex amplitude distribution of the diffracted light from the element hologram 1 of **** A, and (2) Complex amplitude distribution of the diffracted light from the element hologram 2 of the layer A, (3) Complex amplitude distribution of the diffracted light from the element hologram 3 of **** B, and (4) Complex amplitude distribution about peace with the coherent diffracted light from the element holograms 1 and 2 of the layer A, (a) Distribution of the sum of the intensity (square of complex amplitude) of the diffracted light from ********** 1, 2, and 3, (b) Distribution of the intensity about peace with the coherent diffracted light from ********** 1, 2, and 3 (square of complex amplitude), and (c) It is the intensity distribution of the regenerated light detected only when the hologram concerning Embodiments 3 and 4 is illuminated appropriately.
[0056]
[Description of Notations]
1 -- Element hologram 1 of the hologram layer A
2 -- Element hologram 2 of the hologram layer A
3 -- Element hologram 3 of the hologram layer B

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

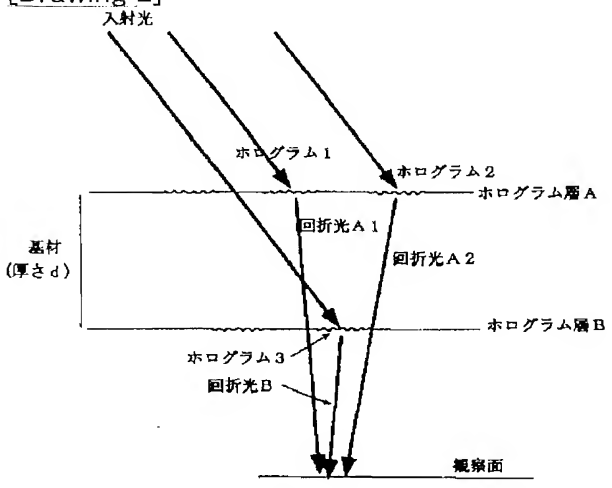
DRAWINGS

[Drawing 1]



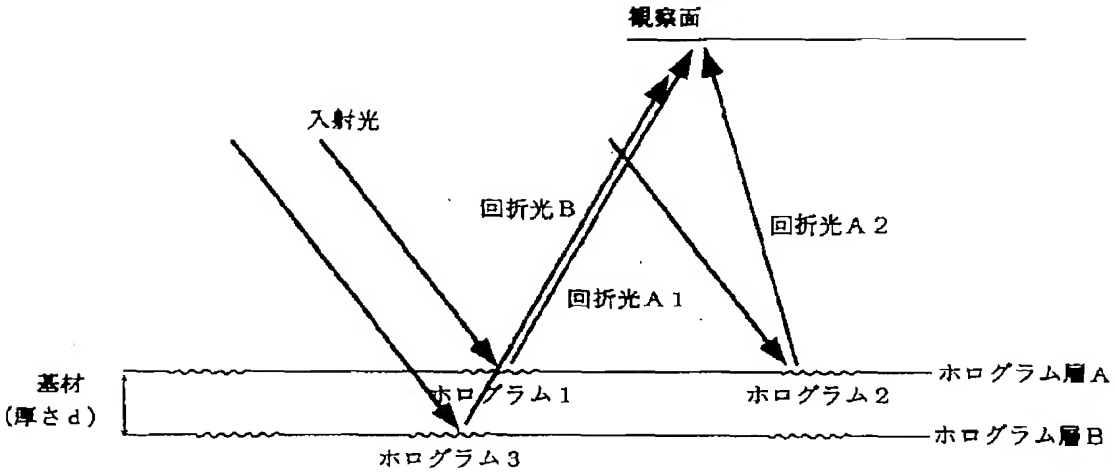
本発明のホログラム（反射型）の再生

[Drawing 2]



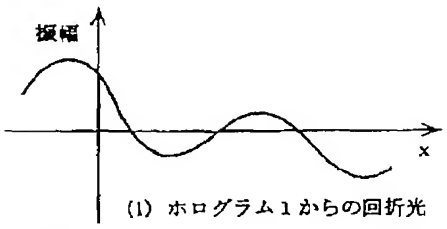
本発明のホログラム（透過型）の再生

[Drawing 4]

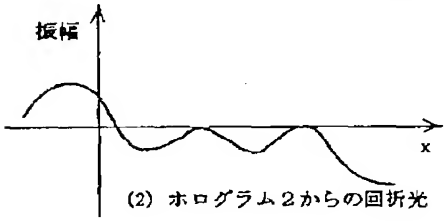


本発明のホログラム（反射型）の再生

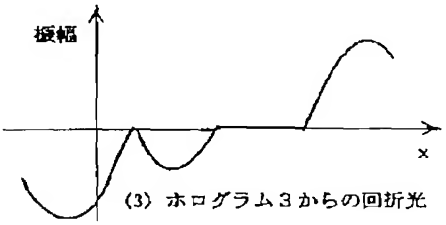
[Drawing 3]



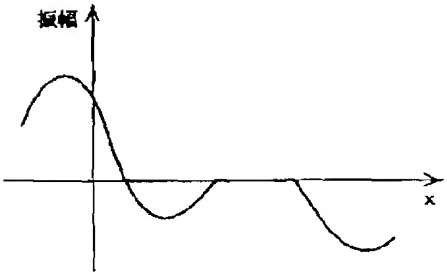
(1) ホログラム１からの回折光



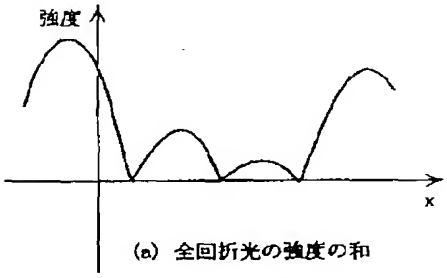
(2) ホログラム２からの回折光



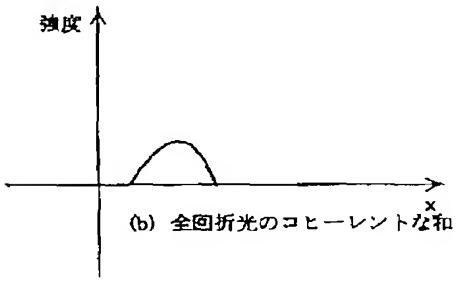
(3) ホログラム３からの回折光



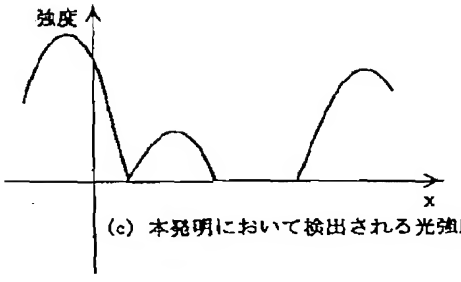
(4) ホログラム１、２からの回折光のコヒーレントな和



(a) 全回折光の強度の和

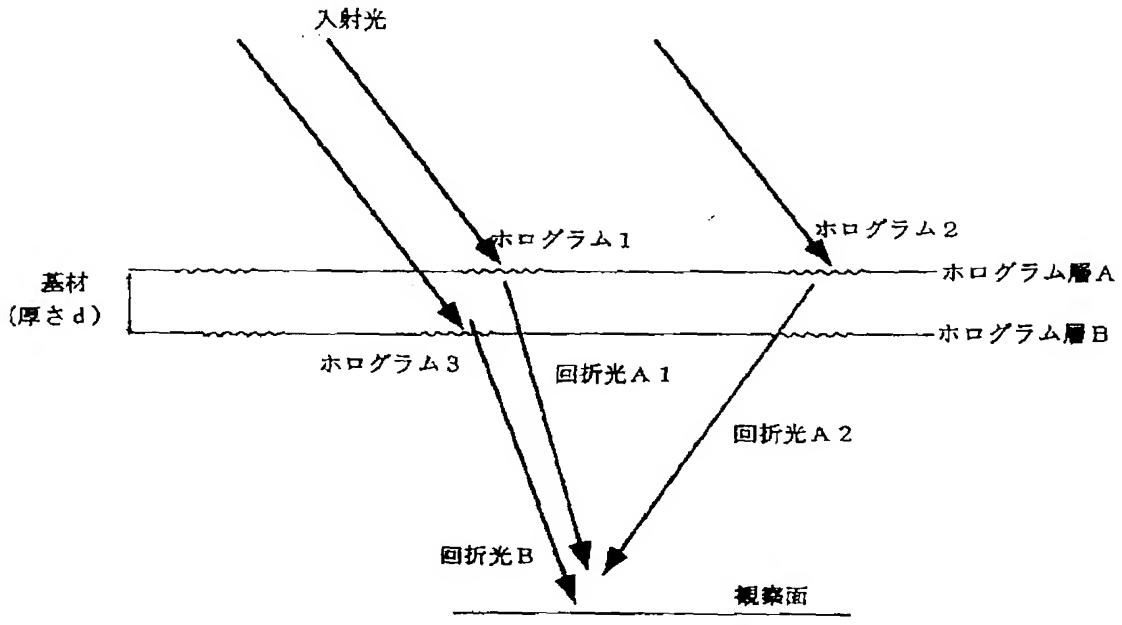


(b) 全回折光のコヒーレントな和



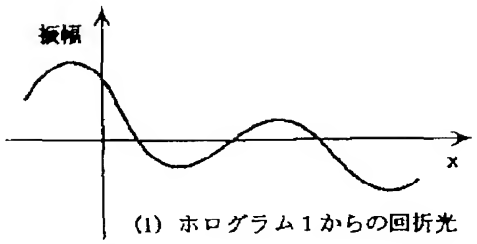
(c) 本発明において検出される光強度

[Drawing 5]

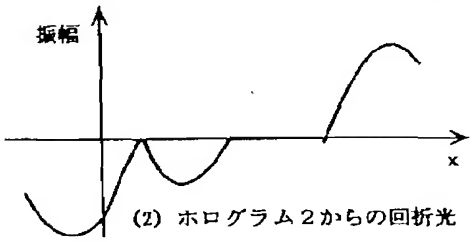


本発明のホログラム（透過型）の再生

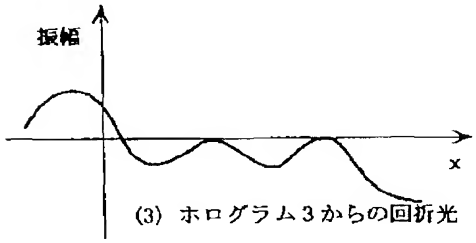
[Drawing 6]



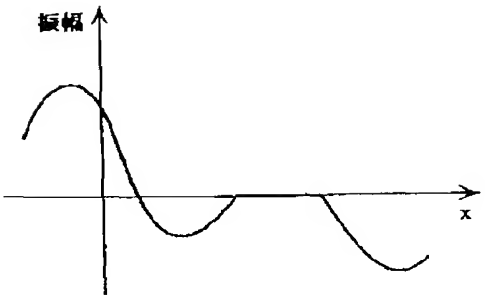
(1) ホログラム１からの回折光



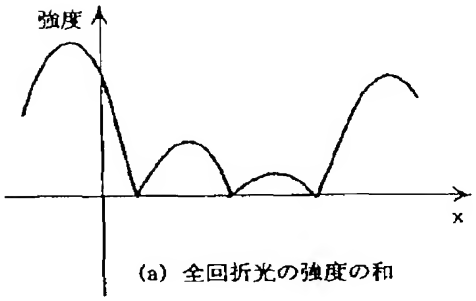
(2) ホログラム２からの回折光



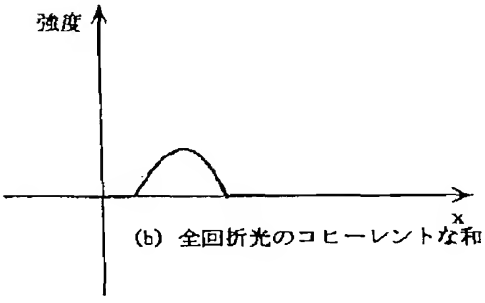
(3) ホログラム３からの回折光



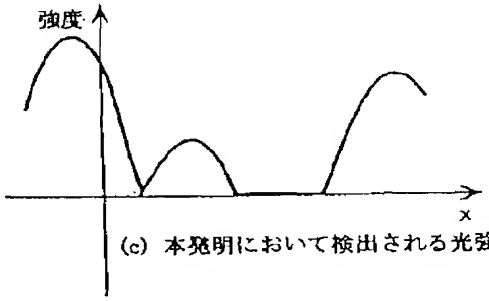
(4) ホログラム１、３からの回折光のコヒーレントな和



(a) 全回折光の強度の和



(b) 全回折光のコヒーレントな和



(c) 本発明において検出される光強度

[Translation done.]